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A Statistical and Spatial Analysis of Chemical Contaminants in Cocos Lagoon, Guam

Char'Mane Robinson
California State University, Monterey Bay

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Char' Mane Robinson
McNair and NOAAEPP/MSI Undergraduate Scholar
California State University, Monterey Bay
Major: Environmental Science Technology and Policy

CSUMB's Teddy Talk
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GUAM
Cocos Lagoon
Coco Island

Background: PCBs

- PCBs belong to a family of man-made organic chemicals known as chlorinated hydrocarbons

- PCBs are extremely persistent in the environment and can be bioaccumulated and then biomagnified in organisms such as fish and humans (EPA, 2016)

- PCBs can cause a variety of adverse health effects in animals and humans such as immune system suppression, reproductive system impacts including birth defects and cancer (EPA,1996).

Previous Research

- In 2005, the US Coast Guard found high levels on and around Cocos Island (USCG, 2014)
- In May 2015, NOAA's scientists sampled sediments and fish throughout the entire Cocos Lagoon
- Samples collected were analyzed for approximately 190 chemical contaminants, including 82 PCB congeners

Project Objectives

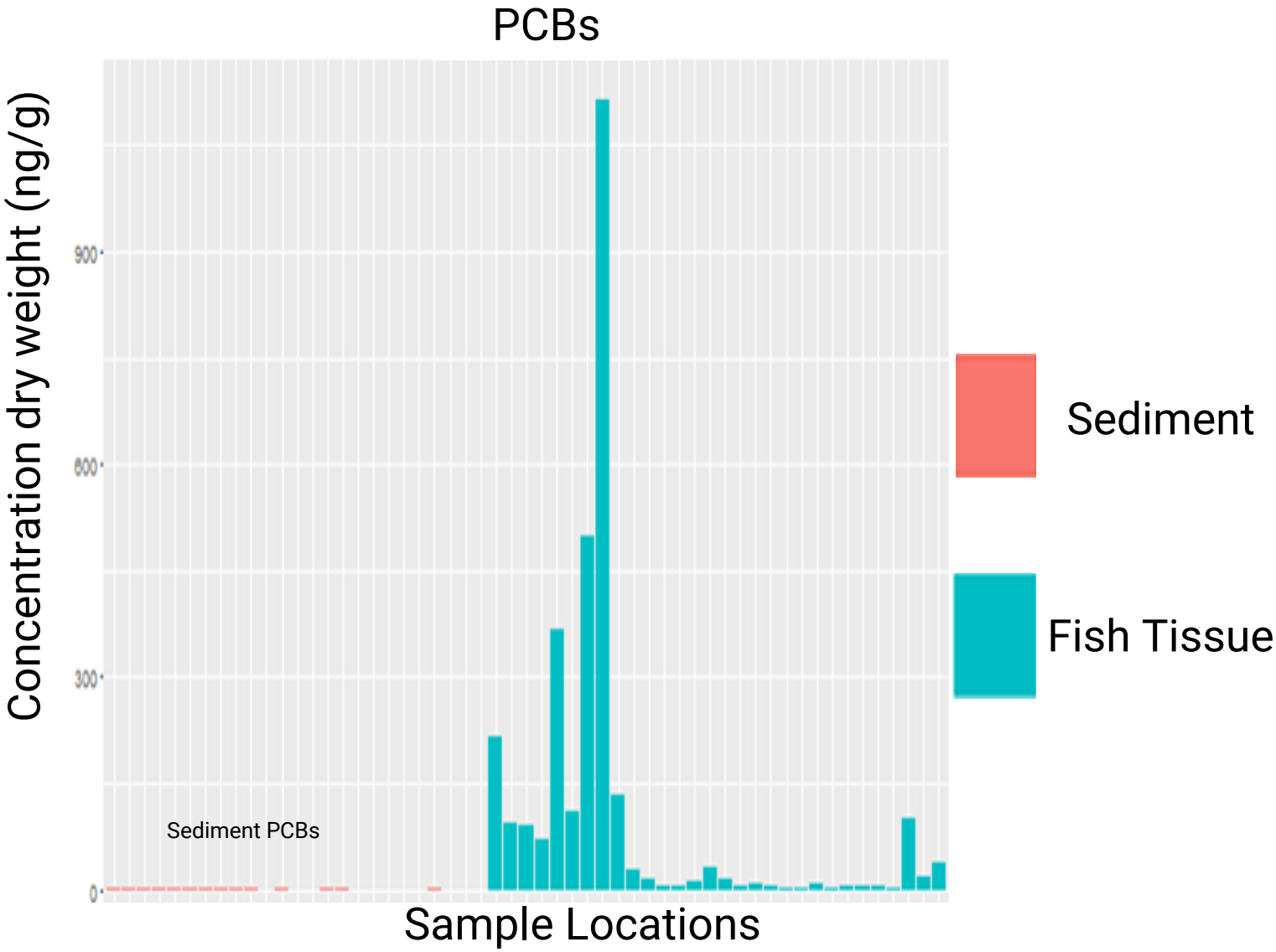
1. Conduct statistical analyses of PCBs in both sediments and fish tissue samples
2. Develop charts and tables displaying the results of the analyses to be incorporated into future NOAA reports and manuscripts
3. Assess the human health risks associated with the chemical contaminants present in Cocos Lagoon

Methodology

- ArcGIS: used to display the concentrations of PCBs in relation to EPA screening values

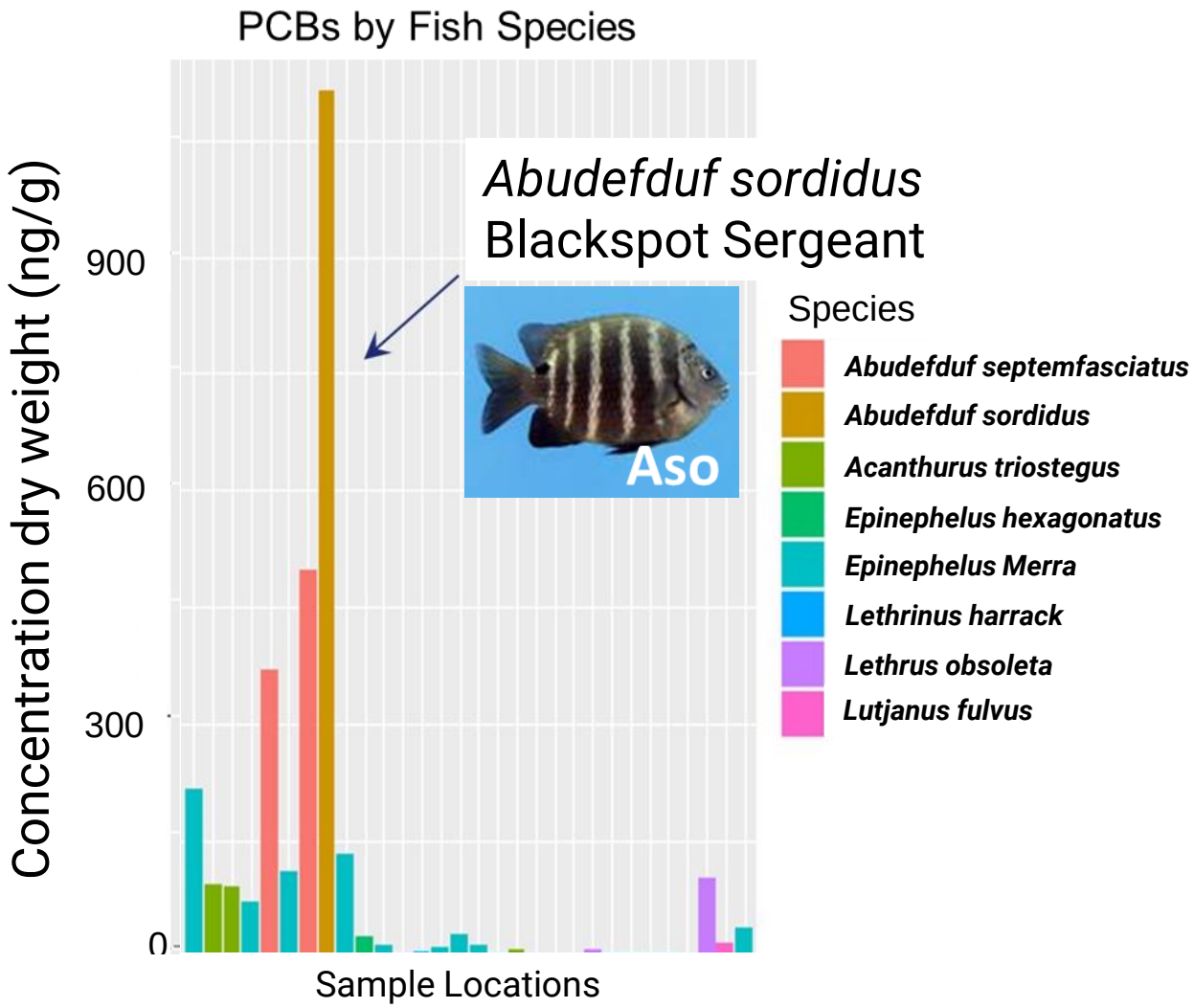
- Statistical Analysis Tools such as JMP (SAS product) and R

Results PCBs in Sediment vs Fish tissues



- PCBs in sediments were much lower, than in the fish samples (≤ 1.20 ng/g).

PCBs Results by Fish Species



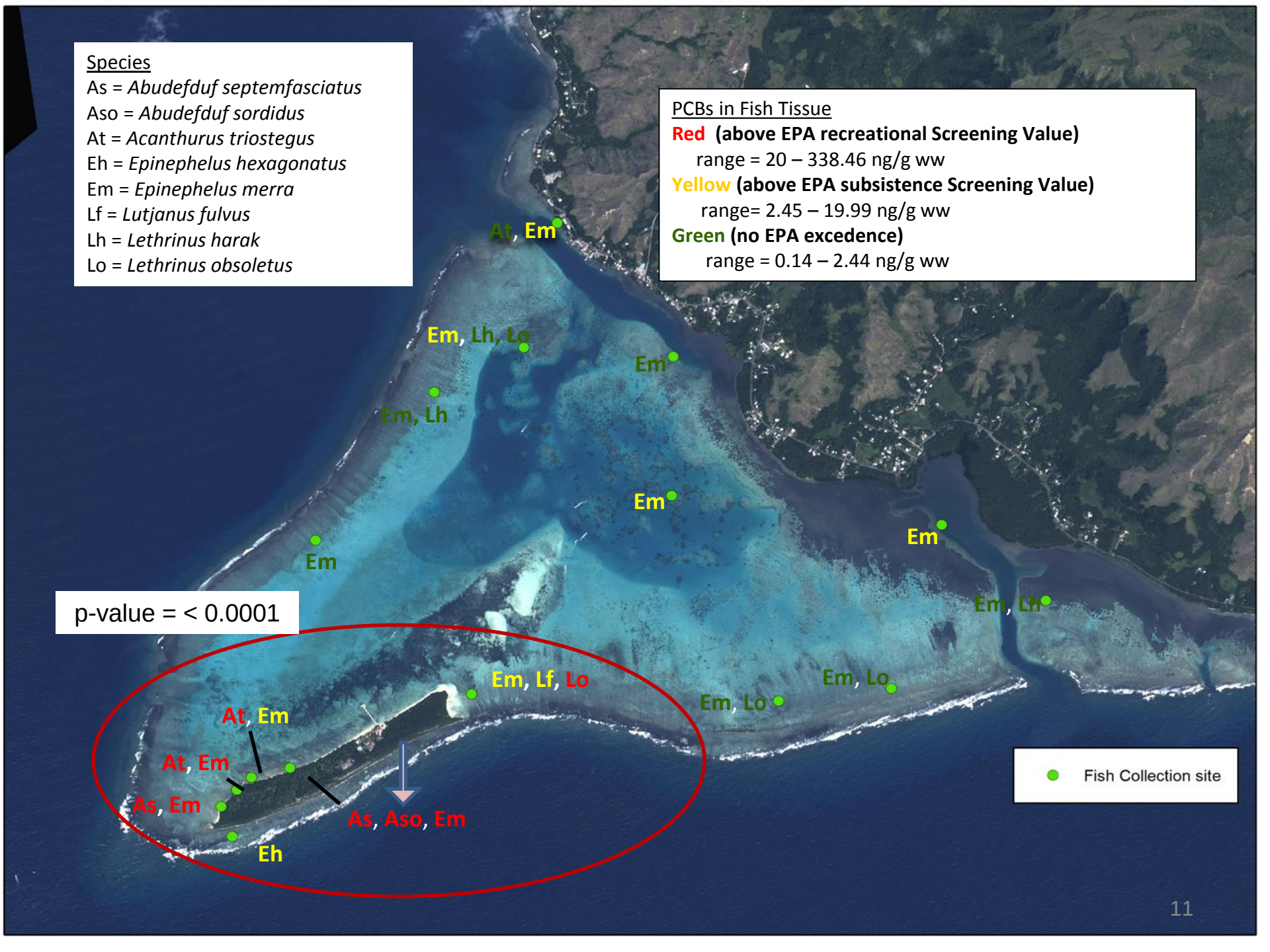
- The total of PCBs accumulated in the Blackspot Sergeant was (≤ 1,200 ng/g)

Results: EPA Screening Values

- Screening values (SV) have been developed by the USEPA to define the risk resulting from the consumption of fish by subsistence and recreational fishers

EPA screening value of PCBs for subsistence fishers = 2.45 ng/g (ppb)

EPA screening value of PCBs for recreational fishers = 20 ng/g (ppb)


Species
As = Abudefduf septemfasciatus
Aso = Abudefduf sordidus
At = Acanthurus triostegus
Eh = Epinephelus hexagonatus
Em = Epinephelus merra
Lf = Lutjanus fulvus
Lh = Lethrinus harak
Lo = Lethrinus obsoletus
PCBs in Fish Tissue
Red (above EPA recreational Screening Value)
range = 20 – 338.46 ng/g ww
Yellow (above EPA subsistence Screening Value)
range= 2.45 – 19.99 ng/g ww
Green (no EPA excedence)
range = 0.14 – 2.44 ng/g ww
At, Em
Em, Lh, Lo
Em
Em, Lh
Em
Em
Em
Em, Lh
p-value = < 0.0001
Em, Lf, Lo
Em, Lo
Em, Lo
At, Em
At, Em
As, Em
As, Aso, Em
Eh
Fish Collection site

Next Steps

1. During the Fall, I will write the results of my analyses that will be included in report and submit for publication as a NOAA tech memo and journal articles.
2. To better protect human health and the environment further additional remediation of the former USCG LORAN site, and the monitoring of chemical contaminant concentrations in water and biota adjacent to Cocos Island
3. In conjunction with recent biota testing results, the NOAA results will be used to assess the current fishing advisory area within Cocos Lagoon

Literature Cited

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Acknowledgments

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Questions ?

Results: Fish Species Analyzed

Abudefduf septemfasciatus
Banded Sergeant

Abudefduf sordidus
Blackspot Sergeant

Acanthurus triostegus
Convict Tang

Epinephelus hexagonatus
Starspotted Grouper

Epinephelus merra
Honeycomb Grouper

Lutjanus fulvus
Blacktail Snapper

Lethrinus harak
Thumbprint Emperor

Lethrinus obsoletus
Orange-striped Emperor

Photos courtesy D. Burdick/ http://www.guamreeflife.com/


Stratum 3
Stratum 2
Stratum 4
Stratum 1